1. Detailed Actions Analysis

Regional effects discussion

2. Costs of Aquifer Overdraft

Roger Mann, PhD
RMann Economics

Today

- Review draft estimation methods and results for detailed actions analysis
- Take comments regarding methods, assumptions and presentation
- Discuss and take comments on regional effects discussion
- Discuss and take comments regarding costs of aquifer overdraft memo

Detailed Actions Analysis

Many assumptions required

Assumption means a hydrologic or economic number that should be most-reasonable for representative case

Essentially a forecast: most reasonable future

Spreadsheets are structured so assumptions can be easily changed

Assumptions not very uncertain or don't matter

- Planning horizon: 100 years
- Discount rate: 2 to 4 percent

Most important assumptions:

- ET: reference ET is 6.3 AF/A, crop coefficients are 0.5 to 0.66. Tamarisk?
- Fate of AW-ET. Default assumes none to groundwater
- Irrigation efficiency 0.7 to 0.8
- Land prices, especially land other than citrus
- Amount of acreage provided by willing sellers at price
- Future population growth; assuming little

Detailed actions analysis is still screening level

- Estimate representative costs and supply from most promising actions
- Identify important economic and hydrologic uncertainties
- Given uncertainties, identify potential range of supply, cost and cost/af
- Compare cost-effectiveness across actions
- To move beyond screening level, need field-level measurement, hydrology, cost engineering

Discounting and Annualizing example

	Discount rate		3.00%		
Column>	B	C	D	E	
	Year or Row	Actual Cost	Annualized Cost	AF Supply	
	1	$5,000.00	$696.97	5	
	2	$100.00	$696.97	5	
	3	$100.00	$696.97	5	
	4	$100.00	$696.97	5	
	5	$100.00	$696.97	5	
	6	$500.00	$696.97	5	
	7	$100.00	$696.97	5	
	8	$100.00	$696.97	5	
	9	$100.00	$696.97	5	
	10	$100.00	$696.97	5	Formula
NPV		$5,945.30	$5,945.30		=NPV(0.03,C1:C10)
Annualized		$696.97			-PMT(0.03,10,5945.3)
$ cost per AFY		$1,189.06			+5945.3/5
$ cost per AF		$139.39			+696.97/5

Irrigated Land Retirement Assumptions and Results							
Agricultural acreage	**Share retired**	Cost /acre	Feet ET	Feet AW-ET	Total AFA	Cost/AFY	Cost/AF
Old stock citrus	50.0%	$13,200	4.10	1.16	5.25	$2,514	$98
Middle-aged citrus	25.0%	$17,200	4.10	1.16	5.25	$3,276	$127
Palm	50.0%	$31,200	3.15	1.35	4.50	$6,933	$269
Potato	50.0%	$21,200	0.80	0.34	1.14	$18,550	$721
Other acreage	**Acres**						
Tamasisk	46.1	$12,215			7.68	$1,592	$62
Golf turf	70.0	$8,000	4.16	1.78	5.94	$1,347	$52
Golf non-turf	95.0	$8,000	3.00	1.29	4.29	$1,867	$73
Golf turf not overseeded	300.0	$5,146	0.38	0.16	0.54	$9,530	$370
Municipal outdoor	61.4	$43,560	3.78	1.62	5.40	$8,067	$314
HOA outdoor	12.1	$43,560	3.78	1.62	5.40	$8,067	$314

Irrigation Efficiency Actions, AF Savings, Cost per AFY and cost $/AF			
Action	Savings	$/AFY	$/AF
Irrigation efficiency on remaining palm, potato and nursery acreage	389	$8,357	$325
Golf irrigation system management (physical and operational, 100 acres	113	$11,864	$461
Maximize citrus irrigation efficiency on remaining acres	230	$10,929	$425
Rehabilitate golf irrigation systems (130 acres)	178	$16,723	$650
Improve HOA irrigation efficiency on most of remaining	26	$28,637	$1113
Municipal landscape audits on most of remaining	133	$31,636	$1230

Floodwater and Wastewater Recovery Actions, AF Savings, Cost per AFY and cost $/AF			
Action	Savings	$/AFY	$/AF
Viking Ranch 150 acre stormwater project	300	$34,416	$1338
De Anza Country Club 24 acre stormwater project	154	$14,341	$557
Wastewater percolation ponds and water recovery	80	$7,475	$291

Sensitivity Analyses

	2009 AFY Baseline	Gross AFY Savings	Net AFY Savings	Million $ NPV Cost
Default assumptions	22,117	13,819	13,819	$81.81
Discount rate 2%, not 3%	22,117	13,819	13,819	$85.03
Share of (AW-ET) and stormwater reaching groundwater is 50%, not 0%	22,117	13,819	11,514	$81.81
No reduction in irrigated areas, maximize efficiency	22,117	3,458	3,458	$42.18

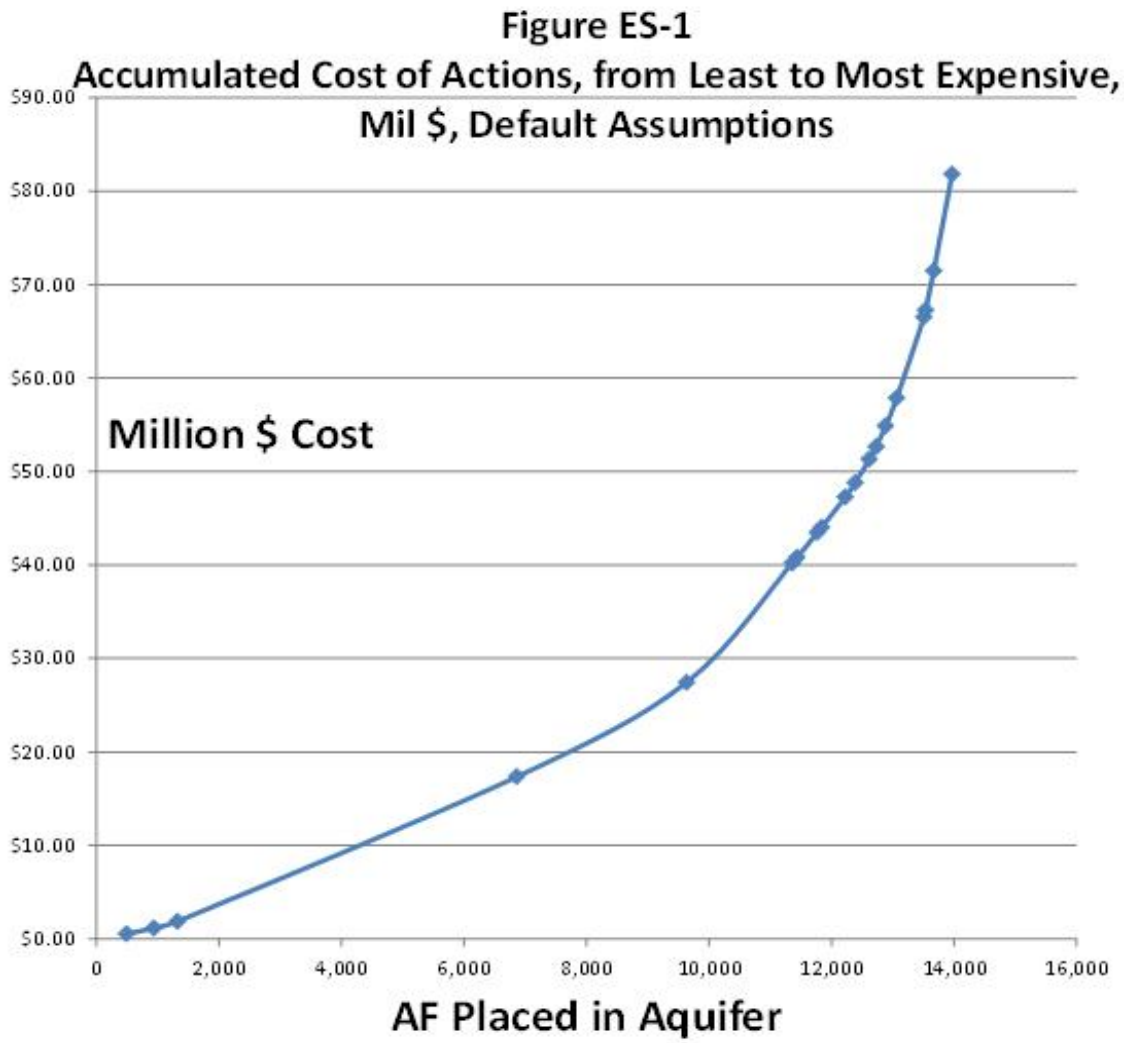
Figure ES-1
Accumulated Cost of Actions, from Least to Most Expensive,
Mil $, Default Assumptions
Million $ Cost
$90.00
$80.00
$70.00
$60.00
$50.00
$40.00
$30.00
$20.00
$10.00
$0.00
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
AF Placed in Aquifer

Findings

- There are no water import projects that appear to be feasible
- Projects to capture more local inflow may be feasible, but such projects appear to have high unit costs compared to most actions, and the potential amount of cost-effective water supply would not reduce overdraft much.
- Without actions to reduce irrigated area there is not enough potential water supply to substantially reduce overdraft.
- Some water use efficiency measures appear to have potential, but most efficiency actions appear to be relatively expensive.

Regional Economics

- Agricultural and golf land retirement or loss of net income could have adverse regional effects
- These effects are related to local spending caused by agriculture and golf
- Golf and citrus have similar gross revenue per acre
- Golf employment per acre appears to be 4 to 5 times more than citrus
- Golf attracts a substantial part-time resident population that spends
- Therefore, adverse regional effects associated with loss of golf acreage are probably much more per acre than for citrus

Costs of aquifer overdraft

- What is the benefit, per AF, of eliminating overdraft?
- Maintain current pump lift. Current decline of 2.7 ft/yr is expected to increase
- Avoid future well replacement costs
- Avoid water quality degradation
- Avoid subsidence and environmental costs
- Save aquifer supply for future use

Assumptions

Discount rate 2% to 4%

Rate of decline 2.7 ft/year, increasing 1% per year: 4 feet per year by 2053, and 6 feet by 2094.

Sensitivity analysis 2% per year

Cost of electricity $0.08 per kwh increases 2% per year

Well cost: golf/irrigation $75K, domestic $15K

Well life: 50 years with no decline, 30 years with decline

TDS increases 1.67 mg/l/year, cost $0.15 per mg/l per household

BWD costs: $50 million in 2039-40, $50 million advanced treatment 2049

Default assumption: no overdraft forever

Sensitivity: what if saved water can be used for new residences in 50 years?

If so, benefits are net income from development

net income from water sales

net income from increased spending

Economic Benefit per AF of Overdraft Reduction, $/AF

	Discount Rate		
Assumptions	**2%**	**3%**	**4%**
2.7 feet decline per year	$54.76	$39.94	$29.37
2.7 feet plus 1% decline per year	$79.04	$55.90	$39.76
2.7 feet plus 2% decline per year	$120.75	$82.62	$56.65
2.7 feet plus 1% decline per year			
With WQ cost $0.15/mg/l, 1.5 mg/l more/year	$81.05	$57.56	$41.14
Add new BWD pumps, distribution, 2039-40	$127.16	$106.09	$89.54
Add BWD advanced treatment, 2049	$165.44	$142.83	$123.00
Add non-BWD well life up from 30 to 50 yrs	$169.85	$147.01	$126.87
Add ability to sell saved water			
Build 12,590 new homes in 2064	$344.36	$280.32	$224.74
Include $5,000/home in annual net incomes	$1,742.15	$1,179.10	$787.81

Summary

The estimated benefit per AF of overdraft avoided from:

- increased energy costs from pumping lower groundwater tables is $30 to $120 per AF, depending on the discount rate and rate of groundwater decline
- loss of wells when groundwater tables fall below well intakes is about $50 per AF. Most of the benefit is associated with new BWD pumps and distribution required by 2040.
- water quality and water quality treatment costs is $35 to $40 per AF. Most benefit involves the avoided cost of advanced treatment required by 2050.

Subsidence and environmental benefits could not be estimated

The benefit of saving water to allow for future growth could be very large from the regional perspective.

Comments?

Please provide any comments by May 8 to

rmecon@sbcglobal.net